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**Mine Examination Report  
June 28, 1978**

Confidential Claim Retracted

Authorized by: SC

Date: 6/30/78

**The Anaconda Company  
Jackpile-Paguete Mine  
Pueblo of Laguna Uranium Leases 1, 4 and 6  
Townships 10 and 11 North, Range 5 West, NMPM  
Valencia County, New Mexico**

**U. S. Geological Survey  
Conservation Division  
Area Mining Supervisor  
Southern Rocky Mountain Area  
P. O. Box 26124  
Albuquerque, New Mexico 87125**

**Dale C. Jones  
Mining Engineer  
July 19, 1978**



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POL-EPA01-0006595

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The writer inspected the underground and open-pit uranium mining operations at The Anaconda Company's Jackpile-Paguate Mine June 28, 1978. He was accompanied underground by Mr. Ronald Ringhand and through the open-pits by Mr. Jim Olsen, both of Anaconda. Prior to the underground inspection, the writer discussed the underground operations with Mr. John Nelson and Mr. J. R. Anderson of Anaconda, and the open-pit operations were discussed briefly with Mr. Robert Chambers of Anaconda after the pit workings were examined.

The Jackpile-Paguate Mine is located within contiguous Pueblo of Laguna Uranium Leases 1, 4, and 6. These leaseholds occupy approximately 7500 acres of the Laguna Indian Reservation in Townships 10 and 11 North, Range 5 West, Valencia County, New Mexico. Uranium mining has been continuously conducted within the properties since 1952, and the ongoing open-pit and underground activities constitute the largest uranium mining operation in the United States, and perhaps in the world. During 1977, the open-pit mining produced approximately 2,500,000 tons of ore with an average grade of about 0.13 percent uranium oxide (%  $U_3O_8$ ) while the underground activities produced about 250,000 tons of ore averaging approximately 0.21%  $U_3O_8$ . About 1,250,000 tons of protore, low grade material associated with the open-pit ore, averaging about 0.025%  $U_3O_8$  was stockpiled in conjunction with the 1977 open-pit mining for possible shipment to the mill in the future. During May 1978, production was 24,419 tons averaging 0.06%  $U_3O_8$  from the open-pits and 5,474 tons averaging 0.20%  $U_3O_8$  from underground with 36,501 tons of protore averaging 0.03%  $U_3O_8$  being stockpiled.

#### P-9-2, P-9-3 and 9-11 Adit Projects

Approved in 1974, the P-9-2 Adit Project was conducted to recover about 58,000 tons of remnant ore from the mined out P-9-1 area on the southeast edge of the South Paguate Pit. Three adits were driven below the ore bodies from the pit bottom using an Alpine Miner (mechanical mining machine) and conventional methods where necessary. Mining was accomplished by modified room-and-pillar stoping with sublevel trackless haulage and conventional mining equipment. Longwall stoping with the Alpine Miner was used where feasible. The operation was halted in 1976 pending further exploration and evaluation, and there has been no underground activity since that time.

The P-9-3 and P-11 Adit Projects were approved in 1975 as a modification of the P-9-2 Adit Project. These projects were designed to recover about 81,000 tons of remnant ore to the north and northeast of the P-9-2 area. Two adits were driven from the pit bottom using the Alpine Miner where possible and conventional methods where necessary, but mining was postponed pending further exploration and evaluation. There has been no underground activity in the P-9-3 and P-11 areas since completion of the adits.

The P-9-2, P-9-3 and P-11 Adit Projects were not examined during this inspection because no underground operations are being conducted. The P-9-3 ore bodies will be extracted by open-pit methods in the South Pagate-9 (SP-9) pushback while the P-11 ore bodies will be open-pit mined in the SP-16 and SP-26 pushbacks. Any remaining P-9-2 ore will be recovered by open-pit mining in the SP-25, SP-25E and SP-40 pushbacks.

#### P-15/17 Mine Project

The P-15/17 Mine Project was approved April 21, 1978, and provides for the extraction of an estimated 1,000,000 tons of ore averaging about 0.23%  $U_3O_8$ . Ore depths range from 260 to 650 feet. Access will be provided by one double track adit or two smaller, parallel adits driven from North Oak Canyon on a southwest bearing beneath the ore under Black Mesa, and mining will be accomplished by modified room-and-pillar stoping with sublevel track haulage. Twenty-two 42-inch inside diameter boreholes equipped with surface fans will be completed during the project to adequately ventilate the mine workings. The life of the mine is estimated to be about 5 years with a maximum production rate of about 950 tons of ore per day.

The P-15/17 Mine Project was not examined during this inspection because no operations are presently in progress. Anaconda has drilled three test wells in the area in an attempt to find a water well to provide service water for the mine. About 30 gallons of water per minute (gpm) will be required, but none of the three test wells could provide this quantity. One of the wells did yield about 5 gpm, and pump tests will be conducted to determine if this yield can be increased.

#### PW2-PW3 Adit Project

The PW2-PW3 Adit Project was approved January 11, 1978. This small, scram type operation is designed to extract approximately 36,500 tons of remnant ore averaging about 0.27%  $U_3O_8$  from the northwest edge of the mined out North Pagate Pit. Although the average ore depth is only about 150 feet, this ore could not be open-pit mined due to its close proximity to the village of Pagate and State Highway 279. It is estimated that the mining operations will be completed in about 2 years.

The PW2-PW3 Project is almost identical in purpose and procedure to the previously discussed P-9-2, P-9-3 and P-11 Adit Projects. Access to the ore will be gained through an adit driven from the pit bottom at the lowest ore elevation and breakthroughs will be driven to the open-pit area as necessary and possible for ventilation. The adit and breakthroughs will be driven by conventional drilling and blasting methods with LHD equipment and underground trucks or by an Alpine

Miner wherever possible. Ore extraction will be accomplished primarily by modified room-and-pillar stoping with conventional jackleg drills, slushers, LHD's and trackless haulage equipment. The lowest ore bodies will be mined directly from the main haulage drift while the higher ore will be transferred down raises to the main haulage drift.

Development of the PW2-PW3 Project began in the later part of February 1978 with collaring of the main adit portal. The development operations were in progress at the time of this inspection, but there was no immediate activity due to mechanical problems with the LHD equipment. The writer inspected the mine workings with the following findings.

The main adit and a breakthrough adit have each been driven 60 to 70 feet into the pit wall. About the first 25 to 30 feet of each adit was driven by an Alpine Miner, but conventional drilling and blasting with Wagner Scooptram LHD equipment has been used since then. The Alpine Miner is presently being modified and will soon be put back into operation in one of the adits. Two crosscuts on approximately 30-foot centers have been started (5 to 10 feet of advance) about 30-feet inby each portal. At least one of the crosscuts between the adits will be completed in the near future to establish circulation of ventilating air through the mine workings. The development operations are being accomplished by two crews of two men each working one 8-hour shift per day, 5 days per week.

The two adits are presently ventilated by 25- and 50- horsepower surface fans located at the portals. These fans provide 10,000 and 25,000 cubic feet of intake air per minute (cfm) respectively with vent bag extending from each fan to the working face. When the Alpine Miner is put back into operation, the 50-horsepower fan will be set to exhaust that particular adit. No ground control problems have been encountered as yet. Approximately the first 25 to 30 feet of each adit are supported by steel sets on 5- to 6-foot centers with tight timber lagging; from there to each working face, split-set rock bolts with wire mesh are used. One adit has encountered a small inflow of water which has been soaking into and being removed with the muck. When necessary, a small sump will be constructed and a sump pump will be installed to pump the water to existing holding ponds in the mined out areas of the open-pit.

The cutoff grade at the PW2-FW3 Project is 6 feet of ore with an average grade of 0.10%  $U_3O_8$ . Material averaging between 0.09 to 0.03%  $U_3O_8$  is being stockpiled for possible future treatment while material averaging lower than 0.03%  $U_3O_8$  is classified as waste and is dumped in the mined out open-pit area near the main adit portal. During the period June 1 through 27, 1978, 759 tons of ore averaging 0.22%  $U_3O_8$  had been shipped from the PW2-PW3 Project. As yet, no longhole or definition drilling has been conducted in

conjunction with the underground operations at the PW2-PW3 Project, and the reserves have been estimated from surface drilling. When the development work has been completed, drilling will be performed underground and the reserve estimates modified accordingly.

#### P-10 Mine

The P-10 Mine is the largest producing underground mining operation at the Jackpile-Paguete Mine. The mining plan was approved August 31, 1973, and a modification of the plan was approved December 12, 1975, to include the mining of the northwestern P-7 ore bodies through the P-10 workings. Operations are presently conducted two 8-hour shifts per day, 5 days per week, and ore production is just over 1000 tons per day with an average grade of 0.22-0.23%  $U_3O_8$ . Total employment, including surface personnel, is 185 hourly and 36 salary employees.

The P-10 and P-7 ore bodies are at an average depth of 500 feet with individual depths ranging from 300 to 600 feet. Access to the ore bodies is provided by a declined shaft approximately 2000 feet long on a 12% slope. This decline is about 9 by 16 feet in cross-section and is supported by steel sets and tight timber lagging throughout its length. A 24-inch wide conveyor belt is located on the north side of the decline and carries ore and waste from the jaw crusher at the decline bottom to the surface. A sump and pump station are also located at the bottom of the decline to collect mine water for transfer to the surface.

Although there are slight differences in the mining procedures used in the various areas of the mine, ore extraction is generally accomplished by modified room-and-pillar stoping with sublevel track haulage. Conventional equipment such as jackleg drills, double and triple-drum slushers and LHD's is used. Since the P-7 area is considerably drier than the P-10 area, LHD's are used for stope development and pillar extraction, and the P-7 ore level is connected to the haulage level by a ramp to provide access for the LHD's. The use of LHD equipment necessitates larger access and crosscut drifts so the crosscuts in the P-7 area are driven on 50-foot centers to develop pillars approximately 40 feet square. In the P-10 area, pillars vary from 30 to 45 feet square depending on ground conditions. In both areas, pillar extraction procedures vary according to the size of the stope, ground conditions and the operational capabilities of the mining equipment.

At the present time, the P-10 area has twenty active stopes including both development and pillar extraction. Generally, four to five pillar extraction stopes are in operation at all times in this area. The P-7 area has five stopes being developed and two pillar extraction stopes. There are additional ore reserves to delineate in both the

P-7 and P-10 areas, but the development of the P-10 reserves has been postponed to avoid conflict with an ongoing expansion of the South Paguate Pit (pushback SP-20). This open-pit pushback has broken into the P-10 workings at their northernmost extent (1301 stope) and will soon break into the P-7 workings in a mined out and caved area (305 and 306 stopes). The blasting for the pushback is coordinated with the underground personnel to avoid possible safety hazards.

Ground control in the underground workings is maintained primarily with rockbolts and wire mesh. Anaconda has used the conventional expansion shell rockbolts in the past and continues to use them in some stopes and track haulage drifts. However, the use of "Split Sets" is becoming more common, as it is in other New Mexico underground uranium mines, because of the better support characteristics of these full friction type rockbolts. The "Split Sets" are installed with jackleg drills as are the expansion shell rockbolts. Steel mats instead of wire mesh are sometimes used with either the expansion shell rockbolts or the "Split Sets" for ground control, but this practice appears to have lessened since the last mine inspection.

Other types of ground support such as steel and timber sets, timber lagging, stulls and cribbing are also used in the mine but generally only for certain situations and/or conditions. Timber or steel sets with timber lagging are found in areas of permanent excavation such as haulage drift turnouts, shops, lunchrooms and electrical substations. Stulls are used in the access drifts around the stopes primarily to comply with mining regulations, and stulls and/or cribbing are used in some of the stopes to prevent dilution caving. Roof jacks are used for temporary support at the working faces until permanent support (rockbolts and wire mesh) is installed.

It appears that Anaconda is maintaining adequate ground control throughout the mine. The shales interbedded in the host sandstone create control problems when the mining areas widen out, and stop development and pillar extraction adjacent to previously mined out stopes can be quite difficult. However, neither of these problems appear to be significantly decreasing mining recovery. Anaconda estimates that average mining recovery is approximately 90 percent with higher than 90 percent recovery occurring in some stopes. The poorest recovery to date has been 70 percent, but recovery this low has not occurred in over a year. Anaconda is now experimenting with ground control and dilution in an effort to improve overall recovery.

Ventilation of the P-10 Mine is accomplished by circulating approximately 300,000 cubic feet of air per minute through the mine workings. Fifteen 42-inch diameter ventilation shafts have been up-raised from the surface, and fourteen of these vent shafts have been equipped with electrical fans (60 to 100 horsepower) at the surface. Presently, eleven of the vent shafts are upcast while four are downcast, and the negative pressure in the mine causes fresh air to enter the workings through the decline and through

the breakthrough to the SP-20 open-pit pushback. Within the mine workings themselves, the ventilation air is directed to the working areas by secondary fans (10 to 25 horsepower), fan bags and bulkheads where necessary. Anaconda has had no problems with the ventilation system but admits that maintenance of the system is a tremendous job.

Another very important and arduous part of the underground mining operations is ore control. Although the involved ore bodies have been delineated by close spaced surface drilling, every effort is made to exactly locate the ore zones during the underground operations, and this detailed delineation can increase or decrease the ore reserves estimated from surface drilling. Ore reserve grade is 10 feet of ore averaging 0.25%  $U_3O_8$  while the mining cutoff grade is 6 feet of ore averaging 0.10%  $U_3O_8$ .

Underground ore delineation begins with the driving of the track haulage drifts under the ore bodies. Rotary longhole fans are drilled on 25-foot intervals in these drifts, and two rotary drills are in operation at all times to perform this work. Each fan consists of nine holes at angles of 20, 30, 45, 60 and 90 degrees to the horizontal. The results of this drilling and probing are added to the ore reserve information and plays a major role in the planning of stope development. Considerable delineation is also performed during stope development and pillar extraction using standard jackleg drills. Every muck pile and every up and down hole of every drift round are probed, and 50-foot fans are drilled and probed at all access drift intersections. Definition drilling, up and down holes ranging from 10 to 20 feet in length, is performed at every pillar intersection and halfway between pillar intersections. In addition, as many pillar extraction holes as possible are probed prior to blasting the pillar rounds. All of this probing information is used to plan stope development and pillar extraction.

The inflow of water into the mine workings is not a major problem at the P-10 Mine. Water is routed via drill holes and ditches to the sump at the bottom of the decline where suspended solids are allowed to settle out. The water is then pumped up the decline and piped to the P-10 holding pond in the bottom of the South Paguate Pit. Periodically water is withdrawn from this holding pond and used to wet the open-pit haulage roads for dust control. Anaconda estimates that approximately 150 gpm are being pumped continuously from the mine.

During the examination, the writer inspected the 305 and 1502 stopes in the P-7 area. The 305 stope has been mined out, and the natural arching from caving of the strata overlying the mining voids was observed. Pillar extraction operations are underway in the 1502 stope, and the writer observed slushing, LHD tramming, and definition drilling activities. The writer also examined drifting operations in the 1500 track drift. This drift is being

driven by conventional methods under the P-18 ore bodies which are south and northwest of the P-7 and P-10 deposits respectively. The drift crew had just completed mucking out the last drift round with an overhead track mucker and was beginning to drill the next round.

The writer did not examine the P-10 workings due to the lunchtime blasting schedule, but he did examine the mining operations in the 00-2 area. The 00-2 area is located east of the P-10 workings at a depth of about 300 feet. The ore is in two zones, known as the north and south zones, and access was gained by driving a drift on the ore level directly from the P-10 decline to the ore zones. The south ore zone has been developed and pillar extraction is underway; when this zone is mined out, the north zone will then be developed and mined. Mining is being accomplished by modified room-and-pillar stoping using slushers to tram muck from the stopes to a chinaman chute. At the chute, the muck is loaded into Getman underground trucks which tram the muck to the surface through the P-10 decline. Production from the 00-2 area is averaging about 50 Getman truckloads every two shifts. The south 00-2 ore zone lies under State Highway 279, and Anaconda has established a six-station (three on each side of the highway) surface grid in this area to detect any subsidence from the mining operations.

#### Jackpile and Paguate Open-Pits

The adjacent Jackpile and Paguate Open-Pits, also known as the Jackpile-Paguate Pit, have been producing uranium ore since 1952 and 1963 respectively. Operations are conducted three 8-hour shifts per day, five days per week, and total Anaconda employment is 310 hourly personnel and 60 to 65 salaried personnel. Anaconda's stripping and mining operations produce approximately 15,000 to 20,000 tons of overburden and ore per day while the majority of the stripping is done by a private contractor, Hamilton Construction, moving about 100,000 tons of overburden per day. The private contractor works two 10-hour shifts per day, 5 days per week, and uses the remaining 4 hours of each day for maintenance.

The open-pit mining procedures and equipment were described in the writer's inspection report of March 10, 1977, and have not changed significantly since then except that the private contractor's stripping operations appear to have increased considerably. A copy of the March 10 report is attached for reference. It should be pointed out that the two open-pits have been arbitrarily divided into the North and South Paguate Pits (NP and SP) and the North and South Jackpile Pits (NJ and SJ) and that the working areas in the pits are thus designated SP-20, NJ-5, etc.

At the time of this inspection, operations were in progress in both pits. In the South Paguate Pit, stripping operations were being conducted by Hamilton Construction in the SP-9 and SP-20 pushbacks. The SP-9



stripping was almost completed with ore mining by Anaconda to follow, and the SP-20 stripping has broken into the P-10 and possibly the P-7 underground workings (mined out stopes). In the Jackpile Pit, both stripping and mining were in progress in the NJ-24, NJ-28 and NJ-28N areas due to high ore horizons. Stripping was underway in the J-2-8 area with mining to soon follow, and remnant ore in the pit bottom was being removed in the NJ-5 area. Mining had just been completed in the SJ-3 and SJ-12 areas, and the pit bottoms in these areas will soon be drilled to locate any remnant ore. Drilling was being conducted in the North Paguate Pit to locate any remnant ore in the pit bottom.

In the SP-20 pushback, the overburden is a maximum of 300 feet thick, and it is being backfilled into the mined out SP-4 area. Ore in the SP-20 area is 40 to 60 feet thick. The SP-9 area overburden was 125 to 150 feet thick, and the majority of this material was used to backfill mined out areas in the South Paguate Pit. Some of the SP-9 overburden was placed on a new waste dump. In the NJ-24, NJ-28 and NJ-28N mining areas, overburden thickness ranges from 60 to 140 feet with the main ore horizon situated at a depth of 140 feet. Overburden in the J-2-8 area was about 105 feet thick with an ore thickness of approximately 30 feet. Ore in the NJ-5 area was from 80 to 100 feet thick and overburden in the SJ-3 and SJ-12 areas was 100 feet thick. As much of the Jackpile waste material as possible is being used to backfill mined out areas of the pit.

Anaconda states that no pit slope stability problems have been encountered in the open-pit mining operations. The stripping operations are conducted with 70-foot lifts and 40-foot wide safety berms to result in an overall overburden slope of approximately 62 degrees. All ore zone mining is conducted with an overall pit slope of 45 degrees.

Anaconda estimates that the SP-9 and SP-20 operations will be completed in 1978 after which operations will commence in the SP-16 area. At the same time, ore remnants in the North Paguate Pit will be removed. In the Jackpile Pit, mining in the NJ-24, NJ-28 and NJ-28N areas will also terminate in 1978, and the operations will be transferred to the NJ-17 and 23, NJ-27 and NJ-32 areas.

Reclamation activities at the mine were not examined or discussed during this inspection but will be at a later date. It was noted that future mining in the NJ-17 and 23, NJ-27, NJ-32, NJ-37 and NJ-45 pushbacks will apparently result in the establishment of a new waste dump to the north of these areas. This will be discussed with Anaconda in the near future because it is believed that waste material from these operations should be used to backfill mined out open-pit areas.

(OPIC, SGD.) DALE C. JONES

Dale C. Jones  
Mining Engineer

Original to: Superintendent, Southern Pueblos Agency, BIA  
cc: Governor, Pueblo of Laguna  
Chief, Branch of Mining Operations, USGS  
Through: Conservation Manager, Central Region, USGS  
Files (No. 1 and N.4)